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Observations of the stability of the propagation time of a long television link

No. 1970/23

Research Department, Engineering Division
THE BRITISH BROADCASTING CORPORATION

RESEARCH DEPARTMENT

OBSERVATIONS OF THE STABILITY OF THE PROPAGATION TIME OF A LONG TELEVISION LINK

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Summary

The synchronisation of colour television signal source is facilitated by the use of stable subcarrier and scanning frequencies. However, when the signals have to travel long distances to the point of synchronism, the time-stability of the video link is important if unwanted phase variations are to be avoided. Tests on the London to Glasgow video circuit have shown that such variations are small.

1. Introduction

The ability to synchronise colour television signals from distant sources with signals from local sources is an important requirement of modern television broadcasting. In the United Kingdom, PAL colour television signals are used, with tightly controlled subcarrier and scanning frequencies, and this is a great advantage in designing the synchronisation equipment. However, the usefulness of stable signal sources is reduced if the transmission time from the distant source is subject to variation, since this will cause variations in the phase of the received signals. The phase-stability of PAL colour signals received from distant sources is of particular interest in systems of television source synchronisation such as the BBC Natlock System[1] and field store synchronisers.

Colour bar signals have been transmitted from Television Centre, London, to Glasgow and back, via a looped video circuit.* The received signals were displayed on a 'Vectorscope' at Television Centre which was locked to the local 4·43MHz colour subcarrier. The phase-stability of the Vectorscope was checked by displaying the transmitted colour bars at intervals during the tests and observing that these remained in the same angular position. Observations were made over a period of about one hour.

2. Results

The received signals exhibited a phase 'wobble' of not more than ± 1° at a rate of about 1 Hz. This was accompanied at times by an amplitude variation of about 1%.

A genuine, consistent phase drift was observed of about 10 degrees per hour. This was thought to have been caused by a change in the weather over the transmission path,** which is formed mostly from microwave links; it is estimated that extreme weather changes could give rise to rates of phase variation about ten times greater than those observed. It is also estimated that, over a period long enough to embrace all kinds of weather, the effective path length could vary over a total range of about 180 degrees. This value is probably less important than the rate of change of phase.

The observed rate of change of subcarrier phase of 10 degrees per hour corresponds to an error in frequency of the received subcarrier of about one part in 10^{12}. Hence, for the Glasgow-to-London half of the link and with a perfectly stable and precise subcarrier oscillator in Glasgow, the predicted maximum error in the frequency received in London would be about five parts in 10^{12}. It is of interest to note that the stability of rubidium oscillators, currently being considered for subcarrier generation, is about one or two parts in 10^{11}.

3. Conclusions

The path appeared to be very stable and certainly adequate for the transmission of PAL signals destined to provide the input to a field store synchroniser. If this path is representative of others, no problems should be encountered on this count.

On the other hand, when considering the use of highly stable rubidium oscillators to facilitate television synchronisation, the effects of very long links cannot be discounted.

* A total distance of about 800 miles.

** Phase drift could, of course, result from a drift in the colour subcarrier frequency; this could not be the case here, however, because the observed drift was several times greater than would have occurred had the subcarrier frequency drifted over the full extent of the specified frequency tolerance for the United Kingdom PAL system (± 1 Hz).

4. Acknowledgements

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5. Reference

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